[Proc. Roy. Soc. Victoria, **46** (N.S.), Pt. I., 1933.]

Art. IX.—*Ecological Studies in Victoria—Pt. II. The Fern Gully.*

By R. T. PATTON, D.Sc. (Melb.), D.I.C. (Lond.), M.F. (Harv.), F.R.H.S.

[Read 13th July, 1933; issued separately 22nd December, 1933.]

As in the case of the Cheltenham Flora(6) no attempt has been made to give to the well defined and distinctive association dealt with in this paper a name in conformity with the existing vogue(2) which ignores the fact that associations are primarily recognized by their vegetative characters.

It is termed, temporarily, the Fern Gully association; it occurs particularly in the mountain country in the eastern half of Victoria, and is most luxuriant where the igneous plutonic rock granodiorite or its equivalent lava, dacite, forms the country rock. It is confined generally to the valley floors, and principally lies in the limit of the Mountain Ash forests which themselves are limited by the two factors, chemical composition of the rocks and high rainfall. The giant *Eucalyptus regnans* strictly does not form part of the association, but rather forms the boundary of it. In the shelter of this high forest the fern gully community reaches its greatest development.

The Fern Gully community may be regarded as a remote outlier of tropical rain forest, on account of both its tropical composition and its structure, rather than as a temperate rain forest. It differs from the true tropical rain forest in its very limited occurrence and in the poverty of constituent species, particularly of Angiospermae. Nevertheless, it exhibits many characters which link it generically with the tropical rain forest, and it is therefore best to consider it as a species belonging to this ecological genus. An association in ecology holds the position of species in taxonomic botany. On account of its poverty in certain directions, it might, however, be placed in a genus closely allied to that of the tropical rain forest.

The Habitat.

Although the fern gully association is widespread in its distribution, the individual occurrences are very limited in size and are widely separated from one another. This is due to several limiting factors. It is, in the first place, limited by rainfall, occurring only within the 35-inch isohyet. Within this limit it is again largely restricted by the nature of the geological formations, and within this limit again its development is affected by the physiography of the area.

The outstanding factor of the environment is perhaps the actual site occupied by this plant community. The term "gully" implies that the association is restricted to the floor of the valley. The ranges in which these fern gullies occur are deeply dissected, and upwards of 2,000 feet may occur between the valley floor and the crest of the range. At times this association may be found ascending almost to the top of the valley, as is the case at the Black Spur, where it reaches an elevation of nearly 1,900 feet above sea-level.

In true tropical rain forest the plant community spreads itself over the hillside, and is not restricted by the contour. Here in these more southern latitudes, however, contour becomes an important factor in the development of the association. The valley floor is sheltered from the hot desiccating winds which blow so frequently during December to March. The valley is also sheltered from the cold winds which occur during the winter. There are, unfortunately, no weather-recording stations in the gullies themselves, but the presence of species of the very delicate Hymenophyllales and of Bryophyta indicates that the humidity is always high. Only on one occasion have these plants been seen in a wilted condition. However, there is even in the coolest recesses a microclimate for the lowly epiphytes just mentioned, for they are generally entirely absent from the northern side of the fern trunks as well as from the upper side when the ferns are inclined.

The association is best developed where the bed rock consists of granodiorite or its equivalent lava, dacite. Although these two are chemically similar(5), the soils derived from them are entirely different. In the southern part of the State, the fern gullies are found in the valleys of Jurassic sediments which, however, are chemically similar to granodiorite and dacite. Areas of Silurian and Ordovician sediments are also found sharply contoured, but in these the fern gullies generally do not attain anything like the same development. The degree of development of the association depends partly on the soil, which is usually shallow and very clayey in the Silurian and Ordovician areas; whereas on the other rocks the soil is deeper and increases in depth along the slope towards the valley floor. Within the association itself, the soil becomes much intermixed with humus and decaying organic matter, and its water-holding capacity is accordingly very high. In the interior of the association, owing to the high humidity and consistently moist condition of the debris, wood-destroying fungi are abundant and the destruction of organic remains is always active.

As in the case of true tropical rain forest, this association develops where there is an abundant rainfall. The fern gullies reach their full development in localities with rainfall above 35 inches. As they occur only in the valley floors, the actual

effect of rainfall is accentuated by the drainage from the hillside. The drainage from the higher slopes is probably of more importance to the association than the actual rainfall itself. The rainfall for two stations is given in Table I.:—

TABLE I.—DISTRIBUTION OF RAINFALL OVER THE YEAR.

STATION.	Years of Record.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	TOTAL.
Black Spur ..	20	3·17	2·99	3·94	3·99	6·66	6·40	6·60	6·99	6·83	6·56	4·97	4·52	63·62
Gembrook ..	43	2·79	2·56	3·79	3·50	4·17	4·59	4·30	4·23	4·69	5·20	4·26	3·98	48·06

I am indebted to the Melbourne and Metropolitan Board of Works for the data of the Black Spur and to the Commonwealth Weather Bureau for that of Gembrook. The rainfall is generally of the winter type, but the wettest period does not coincide with the middle of winter. During the spring months a considerable amount of rain is received. The driest period occurs in late summer and autumn when, occasionally, the air is too dry for the tender epiphytes such as species of Hymenophyllales and of Bryophyta.

Although no climatic data are available for conditions within these associations, there is evidence that considerable differences occur within and without the association. In very cold weather the temperature is warmer within than outside, for when frost is thick upon the ground outside the association, there is no frost within. When the surrounding forest of *Eucalyptus regnans* is removed and the protection from the extremes of weather no longer exists, the association no longer retains its normal development.

In the depths of the association where the epiphytes are abundant and where *Australina Muelleri* grows, light becomes a limiting factor. The canopy of the upper story is very much broken and considerable direct sunlight reaches the second story. This second stratum, however, is usually also not closed, and an appreciable quantity of light reaches the tree-fern stratum. This latter generally forms an effective barrier to sunlight, and under it the soil may be quite devoid of vegetation. Where, however, sufficient light does pass through the fern stratum to permit of carbon assimilation, the plant growth is exceedingly herbaceous and delicate. By means of photographic apparatus it is estimated that where plant growth occurs on the ground stratum or on the fern trunks the light is $\frac{1}{50}$ of that in the open air. This value is less than that for some northern hemisphere forests.

Structure.

The Fern Gully is the most complicated association occurring in Victoria, and it is of particular interest because the usual sclerenchymatous character of our vegetation is not so apparent. The component strata of this association naturally interfere with light reaching the forest floor, and in addition, the sheltered location of a gully combined with the shelter of the giant trees of the surrounding Eucalyptus forest permits the growth of species that cannot exist elsewhere in these latitudes.

The several stories are characteristic of the tropical rain forest, but the number of species here constituting the upper story is limited to five trees. These trees, however, are tall, with long slender trunks and with the crown restricted to the upper portion. The typical tropical characters of thin bark and buttress roots do not occur, nor are these trees as tall as those of the tropics. Two of the five, *Acacia dealbata* and *A. melanoxylon*, occur in every individual representative of the association. Less frequent is *Lomatia Fraseri*, which usually only occurs singly, never many together. Only in the most sheltered cases do we find *Nothofagus Cunninghamii*, and it is restricted to the areas of heavier rainfall. The fifth tree, *Atherosperma moschatum*, is never so tall as the others and might be considered as belonging to the second stratum. The shade of these trees varies considerably, that cast by *Acacia dealbata* being very little on account of the exceedingly pinnate leaves and the small size of the pinnae. On the other hand, the Beech, *Nothofagus Cunninghamii*, and the Blackwood, *Acacia melanoxylon*, cast a deep shade. The foliage of *Lomatia Fraseri* is very open and produces very little shade, and in this respect is somewhat similar to *Acacia dealbata*. The foliage of the Sassafras, *Atherosperma moschatum*, is comparatively dense. The crowns of this stratum do not form a complete canopy, and a considerable amount of direct sunlight falls on the second story.

In the second story are a great number of species, and these all have generally large leaves. On this account, and also on account of a more closed canopy, they cast a denser shade than the upper story. The members of this stratum might be regarded perhaps as tall shrubs rather than as small trees. The number of individuals here is much greater than in the upper story, and this adds appreciably to the density of the forest. Among these are two composites, *Olearia argophylla* and *Bedfordia salicina*, which are characteristic species of this association. Besides these there are two other composites, *Cassinia aculeata* and *C. longifolia*, which, however, are not always present. They belong rather to the fringe of the association. Another species of Compositae, *Olearia lyrata*, is sometimes present. Equally characteristic of the association

are *Pomaderris apetala, Prostanthera lasianthos,* and *Hedycarya Cunninghamii.* Two members of this stratum, *Coprosma Billardieri* and *Pittosporum bicolor,* are less frequent, but both have a characteristic habit of commencing life as epiphytes. Both may be seen epiphytic on tree ferns, but as the trees grow in size so the fern is killed, and they then live as an ordinary terrestrial plant. Such epiphytism is common among species of *Ficus* in tropical forests.

The trees forming this stratum do not form a continuous uniform layer, but are somewhat distributed and intercept the sunlight passing through the upper story. Even combined with the upper stratum they do not give a complete covering. Beneath the second stratum and therefore forming the third, occur the tree ferns *Alsophila australis* and *Dicksonia antarctica,* which are more concentrated in the bottom of the gully, and near the water. *Alsophila australis* is not confined to this association, and is found abundantly in the adjoining forest of *Eucalyptus regnans* extending from the floor of the valley to the crest of the ridge. In this adjacent association it is much taller, and may reach a height of some 50 feet. Where the valleys broaden, these two ferns may form a complete tree-fern society. These two species of ferns complete the shade, and it is only in odd places that sunlight reaches the valley floor. Their finest development is obtained only in the shelter given by the other two stories. When the protection they afford is destroyed the ferns never reach their accustomed development. Not so high as these and only occurring spasmodically is another tree-fern, *Todea barbara.* Where sufficient light penetrates the third stratum a large number of small ferns litter the ground in profusion. These form the lowest stratum. Among these is found an exceedingly succulent dicotyledon, *Australina Muelleri,* which belongs to the nettle family, but is devoid of stinging hairs. It is exceedingly delicate, and occurs only in the most sheltered places.

In such a multi-storied community, two characteristic tropical growth forms have the opportunity to develop, namely, lianes and epiphytes. Neither is rich in species. There are three true lianes, *Lyonsia straminea* and *Tecoma australis,* both twiners, and *Clematis aristata,* which climbs by means of an elongated petiole. In all these three cases the climbing shoots when seeking support are spirally curved, the internodes are very elongated, but the development of the leaves is retarded for several nodes back from the apex.

Besides these true lianes there are others which are designated as scramblers, since the climbing habit is not properly developed. Of these, *Rubus parvifolius* has the typical epidermal development of prickles, but of great interest is the grass, *Tetrarrhena juncea,* which possesses on the leaf sheath and on the stem

small spicules of the same form as rose prickles, but exceedingly small. These enable the grass to reach a height of up to 10 feet, and in places it may form an almost impenetrable mass.

In the lower portion of the association epiphytes are in abundance, but here again the number of species is not great. Particular interest attaches to the fact that only one orchid is present as an epiphyte, *Corysanthes diemenica*, and this is found on tree ferns. It is a small perennial producing only one leaf each year. With this exception the epiphytes are wholly cryptogamic, the family Hymenophyllaceae being very well represented. Several of the ground species of Polypodiaceae may occur as epiphytes, and no sharp line of division can be drawn between epiphyte and terrestrial plant in these cases. Particularly abundant as epiphytes are two species of *Polypodium*, *P. diversifolium*, and *P. Billardieri*. The first has a creeping rhizome which travels widely, and the long slender fronds droop gracefully from the tree ferns.

A particular feature of the epiphytic flora of this association is the great development of the Bryophyta. Some hang in long *Tillandsia*-like masses from the lower branches of the trees, but others as *Umbraculum flabellatum* and *Cyathophorum pennatum*, are very densely developed on the tree ferns, particularly towards the base.

Composition.

The composition of the Fern Gully community is important because it is composed of units which are also found in other communities differing widely from one another in their composition taxonomically. This is due to the fact that the constituent species belong to unrelated plant provinces, and in the areas where the fern gullies occur they overlap one another near the limits of their distribution. Associations such as these, which are ecologically distinctive, show the fallacy of a classification on taxonomic principles. This may, it is true, be an extreme case; nevertheless, being so distinctive, it must fit a classification. The general physiognomy of the association at once suggests tropical relationships, and the majority of species are related to the tropical vegetation. This applies in particular to species of Filicales which constitute approximately 50 per cent. of the plants present, and especially to the genera *Trichomanes* and *Hymenophyllum*, which reach their greatest development in the Indomalayan region. In addition to the ferns, there are dicotyledonous genera and families of tropical origin. The family Monimiaceae, to which one member of the upper stratum and one of the second belong (*Atherosperma moschatum* and

Hedycarya Cunninghamii), is, as is pointed out by Engler (4), an excellent example of an oceanic family which is characterized by a number of monotypic genera, of which *Atherosperma* is one. The main development of this family is in latitudes to the north of this area. The family Pittosporaceae, represented by one species, *P. bicolor*, is Australian except for the genus *Pittosporum*, which is very widespread in tropical countries, and which is comparable in the peculiarity of the distribution of its species to the genera of Monimiaceae.

The family Rubiaceae, tropical in so far as its woody members are concerned, is here represented by *Coprosma Billardieri*, a not very tall shrub. On the margins of this association are herbaceous species of this family. Two of the lianes, *Lyonsia straminea* (Apocynaceae) and *Tecoma australis* (Bignoniaceae) belong to families that are essentially tropical. A third, *Clematis aristata*, is a mostly tropical genus, although the family Ranunculaceae is generally temperate in its distribution. It will be noted that the species constituting the ground stratum, the tree ferns, the lianes and epiphytes, as well as some species of the second story, are of tropical origin. These occupy the more sheltered positions in this plant community. With the exception of *Atherosperma moschatum* the upper story is not derived from the tropics.

In striking contrast to this strong tropical element, there is a representative of the so-called antarctic element, *Nothofagus Cunninghamii* (Fagaceae). This genus extends from Victoria to South America through Tasmania and New Zealand. This tree is not universally present in all individual members of this association, but only where the rainfall is higher and the valleys more sheltered. The genus *Lomatia* (Proteaceae) also extends to South America, but it belongs to a family which is essentially xerophytic in habit, and which reaches its greatest development in Australia and South Africa. It is surprising that there should be a genus of this family common to South America, where it is feebly represented, and Australia, while not a single genus is common to South Africa and Australia. The other two trees of the upper stratum are both species of *Acacia*, *A. dealbata*, and *A. melanoxylon*, the latter belonging to the phyllodinous group of the acacias to which the majority of Australian species belong. This genus while being widely developed in Australia is also strongly represented in South Africa. The species of *Acacia* and of Proteaceae really constitute an Austro-South African group.

In addition to these three elements there is also a purely Australian element which is represented by members of the second stratum as *Olearia argophylla*, *Bedfordia salicina*, and *Prostanthera lasianthos*.

TABLE II.

Species Found Commonly Occurring in the Fern Gully Association.

PTERIDOPHYTA.	
Filicales:	
Hymenophyllaceae	Trichomanes venosum
	Hymenophyllum australe
	H. flabellatum
	H. tunbridgense
Cyatheaceae	Dicksonia antarctica
	Alsophila australis
Polypodiaceae	Dryopteris decomposita
	D. punctata
	Polystichum aculeatum
	P. adiantiforme
	Davallia dubia
	Dennstaedtia davallioides
	Athyrium umbrosum
	Asplenium flaccidum
	A. bulbiferum
	Blechnum cartilagineum
	B. Patersonii
	B. discolor
	B. lanceolatum
	B. capense
	B. fluviatile
	Pellaea falcata
	Adiantum aethiopicum
	Pteris tremula
	Histiopteris incisa
	Pteridium aquilinum
	Polypodium Billardieri
	P. diversifolium
	P. gramitidis
Lycopodiales:	
Psilotaceae	Tmesipteris tannensis
SPERMAPHYTA.	
Monocotyledonae:	
Gramineae	Tetrarrhena juncea
	Glyceria dives
Cyperaceae	Lepidosperma elatius
Liliaceae	Dianella tasmanica
Orchidaceae	Corysanthes diemenica
Dicotyledonae:	
	Archichlamydeae
Fagaceae	Nothofagus Cunninghamii
Urticaceae	Urtica incisa
	Australina Muelleri
Proteaceae	Lomatia Fraseri
Ranunculaceae	Clematis aristata
Monimiaceae	Hedycarya angustifolia
	Atherosperma moschatum
Pittosporaceae	Pittosporum bicolor
Rosaceae	Rubus parvifolius
Leguminosae	Acacia melanoxylon
	A. dealbata
Rhamnaceae	Pomaderris apetala
Araliaceae	Tieghemopanax sambucifolius

	Metachlamydeae
Apocynaceae	Lyonsia straminea
Labiatae	Prostanthera lasianthos
Bignoniaceae	Tecoma australis
Rubiaceae	Coprosma Billardieri
Compositae	Olearia argophylla
	Bedfordia salicina
	Cassinia longifolia
	C. aculeata
	Olearia lyrata.

Leaves.

(*a*) *Size and Form.*

In comformity with the general features of tropical associations the leaves of this plant community are comparatively large and are in striking contrast to those of the Cheltenham Flora(6). They are, however, small in comparison with plants of the tropics. In Table III. is given a classification of the leaves of the dicotyledons given in Table II., according to the system of Raunkaier(7). The leaf sizes are as follows:—Leptophyll, less than 25 sq. mm. in area; Nanophyll, from 25 sq. mm. to 9×25 sq. mm.; Microphyll, from 9×25 sq. mm. to $9^2 \times 25$ sq. mm.; and Mesophyll from $9^2 \times 25$ sq. mm. to $9^3 \times 25$ sq. mm.

TABLE III.

Classification of the Leaves according to Raunkaier.

	Per cent.
Leptophyll	9
Nanophyll	18
Microphyll	45
Mesophyll	27

Under Raunkaier's scheme the leaflets of compound leaves are considered as true leaves, and on account of this the first class, Leptophyll, has a higher percentage than would be the case if the area of the whole leaf was considered. There is only one true leptophyllous plant present, *Cassinia aculeata*, and even this possesses leaves which pass into the next class. In the Cheltenham Flora, a true xerophytic community(6), the leaves are almost exclusively leptophyll and nanophyll. Bews(1) has given another method of classification, using length as a criterion, as follows:—Under 1 inch, 1 to 3 inches, and over 3 inches. Bews finds that in particular fossil beds and in the tropics to-day leaves of over 3 inches in length predominate. In this association the percentage of each is given in Table IV.

TABLE IV.

Classification of Leaves according to Length.

	Per cent.
Under 1 inch	18
From 1 to 3 inches	18
Over 3 inches	65

In the above, compound leaves have been omitted. The percentage of leaves over 3 inches in length is comparable to those given by Bews, but it must be pointed out the number of species in this association on which the percentage is calculated is very low.

Associated with size of leaf in tropical and in fossil angiosperms is the entire margin(1). In the case of this association the comparison with the other floras is not maintained, for the majority either have serrate margins or are compound leaves. Of the Dicotyledons given in Table II., only 36 per cent. have entire margins, and among these is included *Acacia melanoxylon,* which in the adult condition possesses only phyllodes. Only one species, *Pittosporum bicolor,* of the two upper strata possesses a true entire leaf.

(*b*) *Structure.*

Bews(1) has noted the fact that the coriaceous or leathery leaf is typical of tropical and primitive vegetations. In the association this character is no exception. The same author has stressed the point that coriaceousness is in no way to be associated with xerophytism. Although the leaves of this association are predominantly coriaceous they nevertheless contain a far higher percentage of water than leaves of the typical xerophytic heath flora. A comparison of the average percentage moisture calculated to the dry weight of ten representative species in this association shows a value of 220 per cent., as compared with 127 per cent. for that of the Cheltenham flora. Some leaves contain a very high percentage of water, as for instance *Bedfordia salicina,* which has a value of 355 per cent.

Apart from this coriaceousness there are, however, other characters present which are usually associated with xerophytes. The leaves of *Bedfordia salicina,* which has the highest percentage of moisture, are so covered with long woolly hairs on the underside that the name Blanket-wood is applied. Another species of Compositae which has a thick covering of hairs on the underside is *Olearia argophylla.* In *Coprosma Billardiera* the leaves are small and the lateral branches end in spines. However, although such characters are present, the plants possessing them cannot be regarded as xerophytes.

Just as there are external features reminiscent of xerophytes so there are internal structures. Hypodermis is present in *Olearia argophylla* and *Hedycarya Cunninghamii,* both of these trees occurring in the second story. Double palisade layer is also present in a great number of species. The cuticle of the leaves is on the whole not very thick, but in *Atherosperma* it is as wide as the epidermal cells.

In plants of the lower strata there are members which have no protection at all. The outstanding examples are two species of Hymenophyllaceae where the leaves are only one cell thick. These plants are exceedingly delicate, and again in *Australina Muelleri,* which has nearly 500 per cent. of moisture calculated to dry weight, there is a structure quite different from the normal. In this there is a single layer of palisade, but the spongy mesophyll is not normally developed. The upper epidermis is very large, almost as wide as the palisade cells, but is exceedingly thin walled.

Discussion.

The presence in this association of so many plants with tropical affinities, and its general tropical features associated with the presence of floral elements from other sources, draw attention to the fact that the composition of plant communities to-day is the outcome of agencies not only of the present day but also of the geological past. The growth forms present, trees, lianes, and epiphytes, are not only tropical, but are also geologically old. Such growth forms are the outcome of the environment.

From the close of the Cretaceous epoch to late Tertiary times the climate of the earth was mild, and subtropical influences were felt far beyond the present limits of the tropics(3). Naturally, with this climate was associated a flora of tropical affinities. In this climate developed the angiospermic flora, but the degree of variation and development was limited by the uniformity of conditions(1). The wide variation of climate that exists to-day is associated with growth forms, plant communities, and their constituent species, that could not have existed under the moist warm uniform conditions of the earlier part of the Tertiary era. This ancient angiospermic flora possessed certain primitive characteristics which have persisted, and which are still present in the tropical floras of to-day.

Besides the growth forms already mentioned, there occur also in this association other tropical features. Woodiness, which is a primitive character, for example, extends to those families of the Metachlamydeae, Compositae, and Labiatae, in which herbaceousness is such a conspicuous feature. In the two grasses present there are characters which are not usually associated with species of this family in these latitudes. The tribe Festuceae, which Bews(1) regards as primitive, is here represented by *Glyceria dives,* a grass in which the habit of tallness is strongly developed. This grass has very broad leaves and is several feet high. In the other, *Tetrarrhena juncea,* the climbing habit is developed.

When the climate became cooler in late Tertiary times there was a contraction of this flora towards the tropics, leaving behind

here and there, in favorable locations, residual portions of this once widespread primitive vegetation. In the particular areas where the fern gullies occur, there is an absence of the extremes of temperature found in comparable latitudes in other parts of the world. One requirement of tropical vegetation that has remained very favorable is the moist condition of the environment. The location of the association at the foot of the valley protects it from desiccating winds, hot or cold. The moist atmosphere, moist soil, and absence of low temperatures, are sufficient to permit this remnant of a past flora to persist. But a short distance from these areas, conditions of environment are so changed that not one factor remains favorable to the development of this primitive type. Thus fern gullies are persisting in latitudes in which the plant types are generally modern. In any residual, naturally there will not be the same richness of the original flora, and so the poverty of species can be explained. These gullies occupy but a very small fraction of the area in which they occur, since they depend upon a favorable combination of soil, contour, and rainfall. As time passed and the environment became less and less favorable to the original primitive flora, so vegetative characters and the habits of plants changed, and new species made their appearance. The response of the plant to the changed conditions of the environment, physiographic, climatic, and biotic, is seen in the types which are so characteristic of the Australian flora as a whole. There is a marked absence in the fern gully of such typical Australian families as Myrtaceae, Casuarineae, Goodeniaceae, Epacridaceae, Dilleniaceae, Stylidiaceae, as well as many characteristic genera. The changing conditions have brought with them changes in the composition of the one-time true tropical association. It would be expected that some members of the floras arising would be found to associate themselves with the old flora. Both *Acacia melanoxylon* and *Lomatia Fraseri* belong to plant groups which produce characteristic xerophytes. Both belong in the upper stratum of the association. The phyllodinous Acacias, to which *Acacia melanoxylon* belongs, are an almost endemic Australian group, and are abundantly present in very dry areas, extending even right out into the desert regions. Proteaceae is richly developed in the xerophytic areas of Australia.

The true southern member of the upper stratum of the association, *Nothofagus Cunninghamii*, has undoubtedly moved into this association on account of the cool moist condition of the habitat. It is a true temperate rain-forest tree. In this plant community it finds a common link with the tropical members in the favorable moisture conditions. As regards temperature the tropical representatives grow side by side with the antarctic because of the lack of extremes; it is never too hot for the antarctic, nor too cold for the tropic.

The presence of such characters as spines on *Coprosma Billardieri* and abundant hairs on members of Compositae, features which one usually associates with xerophytes, in an association dependent upon abundant moisture, can be explained only on the basis either that such characters have arisen due to the steady variation of climate in regard to amount of rain received, or that plants possessing these characters in the drier areas have become associated with this remnant of a once widespread association.

Bibliography.

(1) Bews, J. W. Studies in the Ecological Evolution of Angiosperms. *New Phyt.*, xxvi., 1927.

(2) Braun-Blanquet, J. Pflanzensoziologie. 1928.

(3) Brooks, C. E. P. The Evolution of Climate, 1925.

(4) Engler, A., and Prantl, K. Die natürlichen Pflanzenfamilien.

(5) Patton, R. T. The Factors Controlling the Distribution of Trees in Victoria. *Proc. Roy. Soc. Vic.* (n.s.), xlii. (2), 1930.

(6) Patton, R. T. Ecological Studies in Victoria. The Cheltenham Flora. *Ibid.* (n.s.), xlv. (2), 1933.

(7) Smith, W. G. Raunkaier's life forms and statistical methods. *Jour. Ecol.*, i., 1913.

H. J. Green,
Govt. Printer, Melbourne.